

ICE-48™ MCS-48™ IN-CIRCUIT EMULATOR

Extends Intellec Microcomputer Development System debug power to user configured system via an external cable and 40-pin plug, replacing the system MCS-48 device

Emulates user system MCS-48 device in real time

Shares static RAM memory with user system for program debug

Provides hardware comparators for user designated break conditions

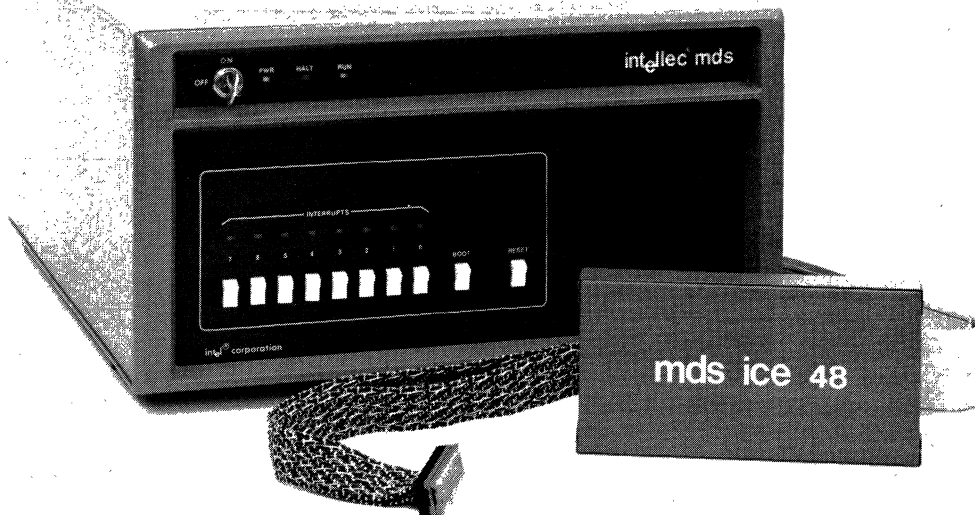
Eliminates the need for extraneous debugging tools residing in the user system

Collects bus, register and MCS-48 status information on instructions emulated

Provides capability to examine and alter MCS-48 registers, memory, flag values, and to examine pin and port values

Integrates hardware and software efforts early to save development time

The ICE-48 module is an Intellec-resident module that interfaces to any MCS-48 system. The MCS-48 family consists of the 8048, 8748, and 8035 microcomputers. The ICE-48 module interfaces with an MCS-48 system through a cable terminating in an MCS-48 pin-compatible plug which replaces the MCS-48 device in the system. With the ICE-48 plug in place, the designer has the capability to execute the system in real time while collecting up to 255 instruction cycles of real time trace data. In addition, he can single step the system program to monitor more closely the program logic during execution. Static RAM memory is available through the ICE-48 module to emulate MCS-48 program and data memory. The designer can display and alter the contents of data and replacement RAM control memory, internal MCS-48 registers and flags; and I/O ports. Powerful debug capability is extended into the MCS-48 system while ICE-48 debug hardware and software remain inside the Intellec System. Symbolic reference capability allows the designer to use meaningful symbols rather than absolute values when examining and modifying memory, registers, flags, and I/O ports in this system.



DEBUG CAPABILITY INSIDE USER SYSTEM

The ICE-48 module provides the user with the ability to debug a full prototype or production system without introducing extraneous hardware or software test tools.

The ICE-48 module connects to the user system through the socket provided for the MCS-48 device in the user system. Intellec memory is used for the execution of the ICE-48 software. The Intellec console and file handling capabilities provide the designer with the ability to communicate with the ICE-48 module and display information on the operation of the prototype system.

BATCH TESTING

In conjunction with the ISIS-II diskette operating system, the ICE-48 module can run extensive system diagnostics without operator intervention. The designer or test engineer can define a complete diagnostic exercise which is stored in a file on the diskette. When activated with an ISIS-II SUBMIT command, this file can instruct the ICE-48 module to execute the diagnostic routine and store the results in another file on the diskette. Results are available to the designer at his convenience. In this way, routine diagnostics and long term testing can be done without tying up valuable manpower.

INTEGRATED HARDWARE/SOFTWARE DEVELOPMENT

The user prototype need consist of no more than an MCS-48 socket and timing logic to begin integration of software and hardware development efforts. Through the ICE-48 module mapping capabilities, Intellec system resources can be accessed to replace prototype memory. Hardware designs can be tested using the system software which will drive the final product.

The system integration phase, which can be costly when attempting to mesh completed hardware and software products, becomes a convenient two-way debug tool when begun early in the design cycle.

REAL TIME TRACE

The ICE-48 module captures trace information while the designer is executing programs in real time. The instructions executed, program counter, port values for Port 0, Port 1, and Port 2, and the values of selected MCS-48 status lines are stored for the last 255 instruction cycles executed. When retrieved for display, code is disassembled for user convenience. This provides data for determining how the user system was reacting prior to emulation break. It is available whether the break was user initiated or the result of an error condition.

For detailed information on the actions of internal registers, flags, or other system operations, the user may operate in single or multiple-step sequences tailored to system debug needs.

MEMORY MAPPING

The 8748 and 8048 contain internal program and data memory. Both program and data memory can be expanded using external memory devices.

When the MCS-48 microcomputer is replaced by the ICE-48 socket in a system, the ICE-48 module supplies static RAM memory as a replacement for the internal microcomputer memory. The ICE-48 module has enough RAM memory available to emulate up to the total 4K control memory capability of the system. The ICE-48 module also provides for up to 320 bytes of data memory.

The ICE-48 module separates replacement control memory into 16 256-byte blocks. Replacement external data memory consists of one 256-byte block. Each block of memory can be defined separately as supplied by the user system or supplied by the ICE-48 module. The user may assign ICE-48 equivalent memory to take the place of external memory not yet supplied in his system.

During final debug stages when external or resident 8748 PROM is used for program execution, the designer can load the program back to ICE-48 memory to test out program changes before reassembly and reprogramming the PROM.

SYMBOLIC DEBUGGING

ICE-48 software provides symbolic definition of all MCS-48 registers, flags, and selected MCS-48 pins. Symbolically defined pseudo registers provide access to the sense of MCS-48 flipflops which enable time, counter, interrupt, and Flag 0/Flag 1 options.

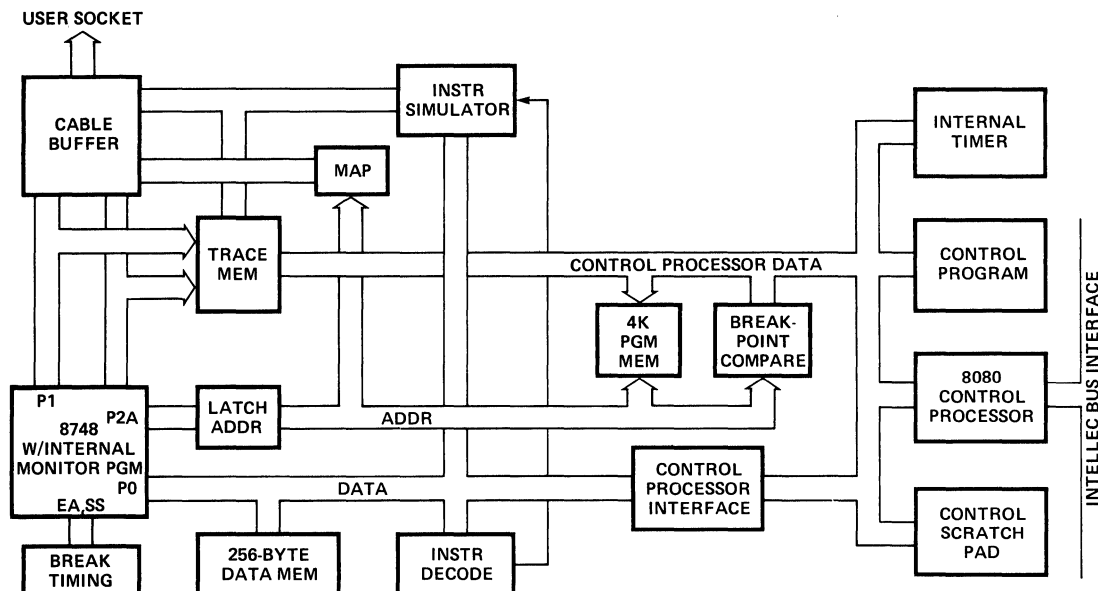
In addition, the user may reference locations in program and data memory, or their contents, symbolically. The user symbol table which is generated along with the object file during a program assembly may be loaded to Intellec memory for access during emulation. The user is encouraged to add to this symbol table any additional symbolic values for memory addresses, constants, or variables that he may find useful during system debugging. Symbols may be substituted for numeric values in any of the ICE-48 commands.

Symbolic reference is a great advantage to the system designer. He is no longer burdened with the need to recall or look up addresses of key locations in his program which can change with each assembly. Meaningful symbols from his source program can be used instead. For example, the command:

GO FROM . START TILL XDATA . RSLT WRITTEN

begins execution of the program at the address referenced by the label START in the designers assembly program. A breakpoint is set to occur the first time the microprocessor writes to the external data memory location referenced by RSLT. The designer does not have to be concerned with the physical locations of START and RSLT. The ICE-48 software driver supplies them automatically from information stored in the symbol table.

ICE-48 MODULE BLOCK DIAGRAM



HARDWARE

The ICE-48 module is a microcomputer system utilizing Intel's 8748 microcomputer as its nucleus. The 8748 provides the MCS-48 emulation characteristics. The ICE-48 module uses an Intel® 8080 to communicate with the Intellec host processor via a DMA port. The 8080 also controls an internal ICE-48 bus for intramodule communication.

ICE-48 hardware consists of two PC boards, the Controller Board and the Emulator Board, which reside in the Intellec chassis. A cable interfaces the ICE-48 boards to the MCS-48 system. The cable terminates in a MCS-48 pin compatible plug which replaces any MCS-48 device in the user system.

REAL TIME TRACE

While the ICE-48 module is executing the user program, it is monitoring port, program counter, data and status lines. Values for each instruction cycle executed are stored in a 255 x 44 real time RAM trace buffer. A resettable timer resident on the Controller Board counts instruction cycles and provides timing for the trace monitor.

CONTROLLER BOARD

The ICE-48 module talks to the Intellec System as a peripheral device. The Controller Board receives commands from the Intellec System and responds through a DMA port.

Three 15-bit hardware breakpoint registers are available which can be loaded by the user. While in emulation mode, a hardware comparator is constantly monitoring address and status lines for a match which will terminate an emulation.

The breakpoint registers provide a signal when a match is detected. The user can disable the emulation break capability and use the signal to synchronize other debug tools.

The Controller Board returns real time trace data, MCS-48 register, flag, and pin values, and ICE-48 status information, to a control block in the Intellec System when emulation is terminated. This information is available to the user through the ICE-48 interrogation commands. Error conditions, when present, are automatically displayed on the Intellec System console.

The Controller Board also contains static RAM memory which can be used to emulate MCS-48 program and data memory in real time. 4K of memory is available in 16 256-byte pages to emulate MCS-48 PROM or ROM program memory. A 256-byte page of data memory is available to access in place of MCS-48 external data memory. The Controller Board address map directs the ICE-48 module to access either replacement ICE-48 memory or actual user system external memory in 256 byte segments based on information provided by the user.

EMULATOR BOARD

The Emulator Board contains the 8748 and peripheral logic required to emulate the MCS-48 device in the user system. A software selectable 6 MHz or 3 MHz clock drives the emulated MCS-48 device. This clock can be disabled and replaced with a user supplied TTL clock in the user system.

CABLE CARD

The Cable Card is included for cable driving. It transmits address and data bus information to the user system through a 40-pin connector which plugs into the user system in the socket designed for the MCS-48 device.

SOFTWARE

The ICE-48 software driver is a RAM-based program which provides the user with an easy-to-use command language for defining breakpoints, initiating real time emulation or single step operation, and interrogating and altering user system status recorded during emulation. The ICE-48 command language contains a broad range of modifiers which provide the user with maximum flexibility in defining the operation to be performed.

The ICE-48 software driver is available on diskette and operates in 32K of Intellec RAM memory.

ICE-48 COMMANDS**EMULATION COMMANDS:**

ENABLE	Activates breakpoint and display registers for use with GO and STEP commands.
GO	Initiates real-time emulation and allows user to specify breakpoints, and data retrieval.
STEP	Initiates emulation in single instruction increments. Each step is followed by a register dump. The user may optionally tailor other diagnostic activity to his needs.
INTERRUPT	Emulates user system interrupt.

INTERROGATION COMMANDS:

DISPLAY	Print contents of memory, MCS-48 device registers, I/O ports, flags, pins, real time trace data, symbol table, or other diagnostic data on list device.
CHANGE	Alter contents of memory, register, output port, or flag. Set or alter breakpoints and display registers.
MAP	Define memory status.
BASE	Establish mode of display for output data.
SUFFIX	Establish mode of display input data.

UTILITY COMMANDS:

LOAD	Fetch user symbol table and object code from input device.
SAVE	Send user symbol table and object code to output device.
DEFINE	Enter symbol name and value to user symbol table.
MOVE	Move block of memory data to another area of memory.

LIST	Define list device.
EXIT	Return program control to ISIS II.
EVALUATE	Convert expression to equivalent values in binary, octal, decimal, and hex.
REMOVE	Delete symbols from symbol table.
RESET	Reinitialize ICE-48 program variables.

SPECIFICATIONS

ICE-48 OPERATING ENVIRONMENT

Diskette-Based ICE-48 Software

Required Hardware:

Intellec® Microcomputer Development System

System Console

Intellec Diskette Operating System

ICE-48 Module

Required Software:

System Monitor

ISIS-II

EQUIPMENT SUPPLIED

Printed Circuit Boards

Interface Cables and Buffer Module

Operator's Manual

Schematic Diagram

ICE-48 Software, diskette-based version

SYSTEM CLOCK

Crystal controlled 6.0 MHz internal, 3.0 MHz internal or user supplied TTL external: software selectable.

PHYSICAL CHARACTERISTICS

Width: 12.00 in. (30.48 cm)

Height: 6.75 in. (17.15 cm)

Depth: 0.50 in. (1.27 cm)

Weight: 8.00 lb. (3.64 kg)

ELECTRICAL CHARACTERISTICS

DC Power:

V_{CC} = $\pm 5V$, $\pm 5\%$

I_{CC} = 10A maximum; 7.0A typical

V_{DD} = +12V, $\pm 5\%$

I_{DD} = 79 mA maximum; 45 mA typical

V_{BB} = -10V

I_{BB} = 20 mA

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: 0°C to 40°C

Operating Humidity: Up to 95% relative humidity without condensation

ORDERING INFORMATION

Part Number

Description

MDS-48-ICE	8048 CPU In-Circuit Emulator, Cable Assembly and Interactive Diskette Software included
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